

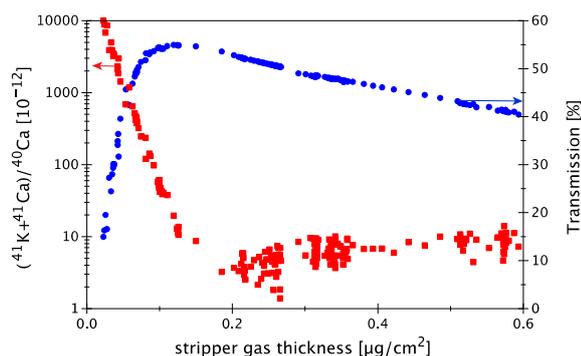
## $^{41}\text{Ca}$ AMS AT LOW ION ENERGIES

### Biomedical applications of $^{41}\text{Ca}$ profit from AMS efficiency gains

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$^{41}\text{Ca}$  is an interesting radionuclide for biomedicine because it can trace the behavior of calcium in the human body, particularly in bones. The very long half-life ( $T_{1/2} = 104$  ka) allows the labeling with very low doses.

AMS is well suited to measure the resulting low  $^{41}\text{Ca}/\text{Ca}$  ratios, but the isobar  $^{41}\text{K}$  interferes in those measurements. Early studies were performed by extracting  $\text{CaH}_3^-$  from the ion source and acceleration to high energies resulting in low background from  $^{41}\text{K}$ . However, the preparation of calcium hydride samples and the measurement at the large AMS accelerators prevented widespread applications with many samples. By extracting  $\text{CaF}_3^-$  from the ion source,  $^{41}\text{K}$  can be suppressed to a large extent (but not as completely as with  $\text{CaH}_3^-$ ). The remaining  $^{41}\text{K}$  background contribution depends very much on the quality of the sample and the sputtering time in the ion source. Usually the  $^{41}\text{K}/^{41}\text{Ca}$  ratio settles after a few minutes of measurement time.



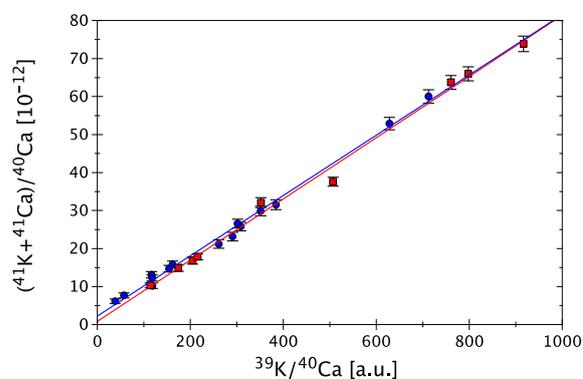
**Fig. 1:** Stripper scan for  $^{41}\text{Ca}$ . The transmission of  $^{40}\text{CaF}_3^-$  to  $^{40}\text{Ca}^{2+}$  is shown in blue, the measured  $(^{41}\text{K}+^{41}\text{Ca})/^{40}\text{Ca}$  ratio in red. At lower stripper gas thickness an increase from molecules at mass 41 is observed.

Previous measurements at the TANDY were performed at a terminal voltage of 500 kV, argon as stripper gas and charge state 3+ [1].

Because of the injected heavy molecule, the available stripping energy of the Ca ions is low, 225 keV, resulting in a transmission of only 4%.

Switching to charge state 2+ with helium as a stripper gas increases the transmissions to more than 50%. Molecular interference at mass 41 can be reduced by increasing the stripper gas pressure to an appropriate value (Fig. 1).

Charge state 2+ also allows the measurement of  $^{39}\text{K}$ , whereas in charge state 3+ this is not possible because of the strong interference of  $^{13}\text{C}^+$ . Using the known ratio  $^{41}\text{K}/^{39}\text{K}$ , the number of detected events at mass 41 can be corrected for  $^{41}\text{K}$  interference (Fig. 2). The background even for samples with high  $^{41}\text{K}$  content is less than  $\sim 5 \times 10^{-12}$ .



**Fig. 2:** Correlation between  $^{39}\text{K}/^{40}\text{Ca}$  and  $(^{41}\text{K}+^{41}\text{Ca})/^{40}\text{Ca}$  of two blank samples, which is used to correct the measured  $^{41}\text{Ca}/^{40}\text{Ca}$  ratio.

The new measurement procedure increased the efficiency about 10 times and also resulted in a higher accuracy due to the possibility to correct for  $^{41}\text{K}$  interference. This allowed us to measure more than 600 samples for a biomedical study within a few weeks of measurement time (see K. Hotz et al., this annual report, p. 83).

[1] T. Schulze-König et al., Nucl. Instr. & Meth. B 268 (2010) 752